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SYLLABUS
OF A COURSE OF
LECTURES ON CHEMISTRY,

BY
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SYLLABUS.

INTRODUCTION.

HISTORY OF CHEMISTRY. Alchemy — Phlogiston—Pneumatic Chemistry.

ATTRACTION OF GRAVITATION. Absolute and Specific Gravity — Hydrostatic balance—Hydrometer, &c.

ATTRACTION OF COHESION. Solid, fluid, and gaseous—different methods of overcoming it.

ATTRACTION OF COMPOSITION, or CHEMICAL AFFINITY. Circumstances in which it takes place—changes produced by it—Single and Double Elective Attraction.

I. FIRE.

HEAT or CALORIC. Different opinions concerning its nature.

Free or Uncombined Caloric—Its properties—produces the sensation of heat—dilatation—tends to an

A

equi-

equilibrium—laws of its transmission through solids and fluids—Thermometer, Pyrometer, Rumford's experiments.

Latent Caloric—its properties—the cause of fluidity and the gaseous state—conversion into uncombined caloric—evaporation, ebullition, solution—freezing mixtures.

LIGHT. Its origin—effects on vegetation, metallic oxyds, &c.

Application of caloric to clothing; construction of ice-houses, stoves, furnaces, boilers—Artificial ice in hot climates.

II. ATMOSPHERIC AIR.

Physical Properties of Air—Rarity, weight, elasticity—pressure of the atmosphere—Torricellian vacuum—Barometer—Syphon—Pump.

Application of the Barometer to measuring heights.

Chemical Properties.—Found, by the experiments of Priestley, Lavoisier, and others, to consist of Oxygenous and Azotic Gasses.

OXYGEN GAS—*Vital or Dephlogisticated Air*—Composed of caloric and oxygen—bodies uniting with oxygen, called oxidable or combustible substances—theory of combustion and formation of oxyds, acids, and oxidated acids—general character of acids—oxygen, whence procured

procured naturally and artificially, tests of its purity.

Used in promoting fusions, &c.

AZOTIC GAS, or Phlogisticated Air—Forms the greatest part of the atmosphere—is incapable of supporting combustion or animal life, whence its name—obtained pure from animal substances.

III. WATER.

WATER. Its sensible properties—found in the state of ice, water, or steam—expands in congelation—highly elastic when in the form of steam—universal solvent—its chemical combinations—decomposed into oxygen and hydrogen.

HYDROGEN, or Inflammable Air. How procured—theory of metallic solutions—explodes with oxygen forming water—combines with some inflammable substances producing peculiar gasses—found native in mines, forming the fire-damp.

Applied to the construction of balloons—history of aerostation.

IV. CARBONIC ACID GAS, or Fixed Air.

CARBONIC ACID GAS—Forms about $\frac{1}{100}$ of the atmosphere—found native in caverns and mines

—procured from alkalies, calcareous substances, and mineral waters, and directly by the combustion of charcoal—is the product of fermentation—heavier than common air—unites with water, rendering it sparkling and acidulous—is the weakest of all acids—effervescence—when united with hydrogen forms hydro-carbonate gas, or *heavy inflammable air*—is fatal to combustion and animal life.

V. RESPIRATION and the ANIMAL TEMPERATURE.

RESPIRATION. How performed in man, quadrupeds, birds, fishes, &c.—changes produced by it on atmospheric air—difference between venous and arterial blood—effects from the respiration of various gasses.

ANIMAL TEMPERATURE. How kept up—warm and cold blooded animals, amphibia, fishes, hibernating animals—equilibrium of animal heat.

VI. ALKALIES.

General character of Alkalies—unite with all acids forming neutral salts—general properties of neutral salts—their nomenclature.

CRYSTALLIZATION. How produced—always affects a regular polyhædral form—influenced by light
—saline

—saline vegetation—solubility of different salts in water.

AMMONIA, or Volatile Alkali. When pure in a gaseous state — of a strong pungent smell and caustic taste—fatal to combustion and animal life—readily absorbed by water—composed of hydrogen and azote—produced naturally by the spontaneous decomposition of water by animal or vegetable substances containing azote—with carbonic acid forms

Carbonate of Ammonia—procured from muriate of ammonia and carbonate of lime—sublimes entire and solid with a gentle heat—easily soluble—is decomposed by lime, giving out pure ammoniacal gas—difference between mild and caustic alkali.

Used in smelling bottles and in medicine.

SODA, or Mineral Fixed Alkali. Procured from carbonate of soda by means of lime—differs only from potash in giving different neutral salts.

Carbonate of Soda, or Natron—Found native in Egypt and some parts of Asia—procured from the ashes of sea-weed, and called *kelp*; or from plants growing on the sea shore, then called

barilla—effloresces in the air—contains the alkali in excess.

Used principally in the making of glass and soap.

POTASH, or *Vegetable Fixed Alkali*. Procured from carbonate of potash by lime—is intensely acrid, and corrodes animal substances—with all oily and greasy substances forms a soap—deliquesces in the air—fuses in a red heat, and dissolves siliceous earth forming glass.

Used in surgery to corrode flesh.

Carbonate of Potash, Salt of Tartar, Salt of Wormwood—In its impure state called *Wood-ash, Potash, Pearl-ash*—procured chiefly from North America and the north of Europe, by burning to ashes any vegetables not growing on the sea shore—when fully saturated does not alter by exposure to the air—table of the products of different vegetables.

Used in making glass, soap, and in many other of the arts.

VII. ALKALINE EARTHS.

Why so called—unite easily with all acids.

LIME. Of an acrid burning taste—corrodes animal and vegetable substances—gives out heat on union

union with water—dissolves in 700 times its weight, forming lime-water—decomposes alkaline carbonates—remarkably increases the fusion of other earthy bodies—procured by heating carbonate of lime.

Used in mortars, cements, stucco, in dying, bleaching, tanning, sugar-baking, as manure, &c.

Carbonate of Lime—Found pure in the different forms of Calcareous Spar, Limestone, Marble, Chalk—found in immense masses throughout the globe—forms the shell of eggs and shell-fish, corallines, &c.—is without taste—scarcely soluble in water—when burned forms quicklime—process of lime-burning.

Used in the reduction of metallic ores—marble used in building, statuary, &c.

BARYTES, or *Ponderous Earth*. The heaviest of the earths—soluble in 900 times its weight of water, and precipitable by carbonic acid—procured by heating carbonate of barytes—has the strongest affinity for sulphuric acid of any known substance.

Carbonate of Barytes—Found hitherto only in Lancashire.

MAGNESIA. Insipid, scarcely soluble — procured from carbonate of magnesia by calcination.

Carbonate of Magnesia—Light, pulverulent, and of a pure white—obtained by decomposing sulphate of magnesia—is scarcely soluble in water.

Used in the finer porcelain.

VIII. ALUMINE.

ALUMINE, Clay, or Argillaceous Earth—is never found pure—but procured pure from alum—forms the chief part of clays, slates, &c.—colour of a pure white—insipid, insoluble in water, has an unctuous feel, is plastic when moistened with water, and contracts and hardens in the fire—combines difficultly with acids—Used in pottery, brick-making, pipe-making, &c.—account of the manufactory of earthen ware.

IX. SILEX.

SILEX. Flinty, or Vitrifiable Earth—in its purest natural state forms rock crystal—is found in precious stones, flint, sand, granite, &c.—is insipid, insoluble except in alkalies and the
fluoric

fluoric acid—when fused with a large quantity of alkali forms a glass soluble in water, called *Liquor of Flints*; with a less quantity forms common glass.

Used for millstones, building, paving, &c. and in glass-making—account of glass-making.

X. MINERAL ACIDS,

With their Radicals and Neutral and Earthy Salts.

SULPHUR. Dry, brittle, of a lemon-yellow, without smell, and little taste—electric when rubbed—found native near volcanoes—procured by sublimation from pyrites, &c. — readily fusible—combines with alkalies and alkaline earths, forming sulphures—with hydrogen forms sulphurated hydrogen gas, or hepatic air—combined with oxygen forms sulphureous and sulphuric acid.

Used in gunpowder, taking impressions, and in medicine.

SULPHURIC, or Vitriolic Acid. Limpid, ponderous, inodorous, intensely sour—attracts water from the air, and gives out heat on mixture with water—the strongest in its attraction of all the known acids—its neutral salts called Sulphates.

Used in bleaching, dying, tanning, &c.—manufacture of sulphuric acid.

Sulphate of Soda, or Glauber's Salt—Very soluble; taste bitter, effloresces in the air.—Used in medicine.

Sulphate of Potash, or Vitriolated Tartar—of little taste, difficult of solution.

Sulphate of Lime, Gypsum, or Selenite—forms hills in various parts of the world—when calcined

forms

forms Plaster of Paris.—Used in modelling, and in cements.

Sulphate of Barytes, Ponderous Spar, or Cawk—Generally found with metallic ores—insoluble in water—not decomposable by single elective attraction.

Sulphate of Magnesia, or Epsom Salt—Taste bitter—very soluble.—Used in medicine.

Sulphate of Alumine, or Alum—Difficult of solution—taste styptic—contains the acid in excess—calcined with certain substances forms pyrophorus.

Used largely in dying, clarifying liquors, &c.—procured from aluminous schistus—manufacture of alum.

SULPHUREOUS ACID. Gaseous, and of a suffocating smell—unites eagerly with water—destroys many vegetable colours—procured by dissolving some metals in the sulphuric acid—its natural salts called Sulphites.

Used in whitening silk.

MURIATIC or Marine Acid, or Spirit of Salt. Its radical unknown—when pure is gaseous and colourless—unites readily with water, giving it a citron tinge—smell suffocating—very corrosive—extinguishes flame and animal life—procured

cured by decomposing muriate of soda with sulphuric acid.

Used in metallurgy, dying, &c.

Muriate of Ammonia, or Crude Sal Ammoniac—Taste penetrating—semitransparent and tough like horn—decomposed by lime, giving out ammoniacal gas—procured in Egypt by the distillation of camel's dung—in this country from soot, horns, bones, &c.

Used largely by dyers, goldsmiths, and braziers, &c.—manufacture of sal ammoniac.

Muriate of Soda, or Common Salt—The most abundant salt in nature—found native in vast beds in Cheshire, Poland, Hungary, and Spain—called Rock Salt—found in brine springs, seawater, and some lakes—decrepitates—easily fuses.

Used in culinary purposes, glazing earthenware, glass and soap making, metallurgy—manufacture of common salt, of soda from salt by Lord Dundonald's process.

Muriate of Potash—Taste pungent—found in seawater.

Muriate of Barytes—Not found native.—Used as a chemical test.

Muriate of Magnesia—Taste bitter—deliquescent—found in sea water.

Oxy-

OXY-MURIATIC ACID—Consists of muriatic acid combined with oxygen—procured from oxyd of manganese—when pure, gaseous, pungent, and suffocating—readily absorbed by water—dissolves gold—destroys vegetable colours.

Used in bleaching linen, cotton, and paper—Apparatus for bleaching.

Oxy-muriate of Potash—detonates with various inflammable substances.

NITROUS GAS. How procured—formed by the union of azote with oxygen—colourless—unfit for combustion or respiration—combines with oxygen, forming nitrous acid.

Used as a test for oxygen gas.

NITROUS ACID. Colour of a high orange—fumes in the air—consists of nitrous gas mixed with nitric acid.

NITRIC ACID. Colourless—the most active and the easiest decomposed of all the acids—very corrosive—combines with all alkalies and earths except silica, and with all combustible and oxydable bodies—diluted with water forms *aqua fortis*—with muriatic acid forms nitro-muriatic acid or *aqua regia*—procured from nitre by the sulphuric acid—Used in dying, in working and assaying metals, and engraving, &c.—manufacture of the nitric acid.

Nitrate

Nitrate of Potash, Common Nitre or Saltpetre—Found native in Spain, Italy, and the East Indies—manufactured largely in France and Germany—when heated, is decomposed and gives out oxygen gas mixed with azote—heated with combustible matter, it deflagrates—is decomposed by sulphuric acid—with charcoal and sulphur forms gunpowder—with sulphur and alkali forms fulminating powder.

Used for preserving meat—in gunpowder, fireworks, &c.—manufactory of gunpowder—construction of nitre beds.

Nitrate of Ammonia—Deflagrates without addition.

Nitrate of Soda, or Cubic Nitre—Earthy Salts of Nitric Acid—Are all decomposed by heat, and deflagrate with combustible matter.

BORACIC ACID, or Sedative Salt. Its radical unknown—a concrete acid, of little taste, and the weakest in attraction of all the acids—sparingly soluble—in solution with spirits of wine burns with a green flame—by heat is converted into a glass, unaltered in its properties, and again soluble in water—found native in some springs in Tuscany—procured by decomposing borate of Soda by sulphuric acid.

Borate

Borate of Soda, or Common Borax—In its impure state called Tincal—imported from the East Indies, and other parts of Asia—taste sweetish and styptic—contains the alkali in excess—when heated loses its water of crystallization, swells, and becomes dry and white; if further heated turns to a glass again soluble in water—is a most powerful flux of all earthy substances.

Used in the making of fine glass and artificial gems—assaying ores and soldering metals.

FLUORIC ACID. Radical unknown—procured from fluuate of lime by sulphuric acid—is gaseous, of a pungent smell, and destructive to flame and animal life—unites eagerly with water—has the peculiar property of dissolving flint and decomposes glass.—Used in etching on glass.

Fluate of Lime—Fluor, or Derbyshire Spar—Found native in Derbyshire—generally near metallic ores—phosphorescent when heated.—Used in ornamental works.

XI. METALLIC BODIES.

General Properties of Metals—Great opacity and specific gravity—peculiar brilliancy or metallic lustre—ductility—malleability—found either native and unmixed, or mineralized with sulphur and arsenic, and then distinguished by hardness, brittleness, and lustre—or united with oxygen, and called Oxyds or *Calces*—or with an acid, and then called Mineral Salts.

Of Mining—Different kinds of mines—method of working them—gangue or matrix—ore—treatment of it when procured—stamping—washing—roasting—smelting or reduction—refining—regulus.

Methodical Arrangement of Metals—Perfect and imperfect—brittle and ductile—acidifiable, &c.

ARSENIC. Sometimes found native—generally as a mineralizer of other metals, especially cobalt and copper—often with sulphur—colour steel-grey—texture scaly—brittle—easily oxidable and volatile—when heated emits a garlic smell—with oxygen forms white oxyd of arsenic and the arsenic acid—reduced by heating with oily matters

matters—with sulphur forms orpiment and realgar—unites with most metals forming brittle alloys, and whitening the coloured ones—all the preparations poisonous.

Used in glass-making—enamelling—dyeing—painting—in various alloys—for poisoning vermin, &c.

MOLYBDENA. Found combined with sulphur—similar in appearance to black lead, but more greasy and not so brittle—very difficult of reduction—colour grey—brittle—destroying the ductility of other metals—united with oxygen forms the molybdic acid.

Not applied to any use.

TUNGSTEN. Found in the state of acid, either with lime, and called *Tungsten*, or *Tunstat of Lime*; or with iron and manganese, and called *Wolfram*—of great specific gravity—steel-grey colour, and difficultly fusible—hardens most metals.

Not used.

COBALT. Found mineralized with arsenic and sulphur—also combined with the arsenic acid and with oxygen—colour light grey mixed with red—fine clear grain, and very brittle—fuses with difficulty—when heated in contact with air is converted to a brown oxyd, which, mixed with powdered flints, is called *Zaffre*—melts into a blue glass forming *Smalt*, or *Powder Blue*—co-

balt dissolved in the muriatic acid forms a green sympathetic ink.

Used in giving a blue colour to glass, enamel, pottery, and porcelain, and in colouring starch.

BISMUTH. Found native, and in the state of oxyd, and mineralized by sulphur—colour yellowish white—easily fusible, and volatile when in fusion—burns with a blue flame, and is converted into a white oxyd called *Flowers of Bismuth*—dissolves rapidly in nitric acid, and precipitable by water in a white powder called *Magistery of Bismuth*, which is blackened by animal and sulphureous vapours—increases the fusibility of other metals—*Sir I. Newton's Fusible Metal*.

Used in pewter—the magistery, as paint.

NICKEL. Found native, and in a state of oxyd; and with iron, arsenic, cobalt, and sulphur, forms *kupfer-nickel*—difficult of reduction—colour reddish white—hard, somewhat malleable—dissolves in most mineral acids forming emerald-coloured crystals, and precipitated blue by ammoniac.

Not applied to any use.

MANGANESE. Found native, in the state of oxyd, or alloyed with iron—colour dull white—texture granular—hard—brittle—difficult of fusion—easily converted to black oxyd by simple exposure to air—parts readily with a portion of
its

its oxygen either by heat or by the action of acids—combines with most other metals.

Used in preparing the oxy-muriatic acid, oxygen gas, and in rendering glass transparent, hence called *Glass Soap*.

ANTIMONY. Found native, in the state of oxyd, combined with sulphur, with the arsenic and muriatic acids—of a silvery white—in large facets—of a brittle texture—moderately hard—easily fusible—melted with access of air sublimes into a light white oxyd called *Argentine Flowers of Antimony*—soluble in most mineral acids—with oxy-muriatic acid forms *Butter of Antimony*, from which the oxyd is precipitable by mere water, forming *Powder of Algaroth*—*Sulphuret of Antimony* boiled with an alkaline solution deposits a red powder called *Kermes Mineral*, with an acid gives *Golden Sulphur of Antimony*—oxyd of antimony fuses into an hyacinthine glass, is soluble in the vegetable acids, with the acid of tartar forms *emetic tartar*.

Used in medicine, in type-founding, and other alloys.

ZINC. Found in the state of oxyd in *Calamine*—mineralized by sulphur, forming *Blende*, or *Black Jack*—with sulphuric acid, *White Vitriol*.—Colour bluish white—texture laminated—of a very harsh feel—slightly malleable—melts in

a red heat; when further heated burns with a brilliant flame, and is converted into a light white oxyd, *Flowers of Zinc*—soluble in most acids, and partly in alkalies—detonates with nitre—mixed in various proportions with copper, forms brass, bell-metal, tombac, &c.—is a component part of pewter.

Used in fireworks, brass-making, and in medicine.

MERCURY, or QUICKSILVER. Found native—alloyed with silver—in the state of oxyd—mineralized by sulphur, called *Native Cinnabar*, and in combination with the nitric and sulphuric acids—colour silvery white—fluid in the common temperature of the atmosphere—when rendered solid by cold, is malleable and resembles silver—volatilizes in a moderate heat—agitated, with access of air, is changed into *Black Oxyd*—heated in air, forms *Red Oxyd*, or *Precipitate per se*—All the oxyds reducible by a red heat—unites with most acids—with sulphuric acid forms a white salt, which turns yellow by hot water, called *Turbith Mineral*—with nitric acid forms a salt, which, when further heated, produces *Red Precipitate*—not directly soluble in the muriatic acid—with the oxy-muriatic acid forms *Corrosive Sublimate*, which unites with an additional portion of mercury, producing calomel—combines with sulphur into *Æthiops Mineral*, and by sublimation forms

Facitious

Faſtitious Cinnabar, or Vermilion—Combines with all the metals except iron, forming *amalgams*.

Used in the working of gold and ſilver ores—in gilding—philosophical instruments—painting—ſilvering mirrors—and in medicine.

TIN. Found in the ſtate of oxyd, or mineralized by arſenic and ſulphur—colour white—ſoft—malleable—crackles on being bent—melts very eaſily, forming, with acceſs of air, a white oxyd called *Putty*—is ſoluble in moſt acids—oxydates rapidly in the nitric—with ſulphur and ſal ammoniac forms *Aurum Muſivum*—when melted adheres to the ſurface of iron and copper—forms alloys with moſt of the metals.

Used as tin-foil in electrical machines—in tinning iron and copper—ſilvering mirrors—*Putty* uſed in poliſhing glaſs and making white enamel—the nitro-muriate of tin uſed in ſcarlet-dying.

LEAD. Found native—in the ſtate of oxyd—with carbonic acid—with ſulphuric acid, and mineralized by ſulphur, forming galena, or *pottery lead-ore*—colour bluifh white—the leaſt ductile, ſonorous, and elastic of metals—very ſoft—eaſily fuſible and oxydable—with different degrees of heat forms the grey oxyd, yellow oxyd, or *Litharge*; red oxyd, or *Minium*, or *Red Lead*—with a ſtrong heat melts

into a yellow glass, which is a most powerful flux for earthy and metallic substances, and vitrifies all the imperfect metals—process of cupellation—use of litharge in making flint-glass—Lead is soluble in all the acids—with the acetous acid forms *Cerusse*, or *White Lead*, and *Sugar of Lead*—all the acid solutions of lead blackened by alkaline sulphures, whence the detection of sugar of lead in wines—forms a very fusible alloy with tin, called *Plumbers Solder*—oxyd of lead partially decomposed by the fat oils rendering them drying.

Uses of lead—in refining gold and silver—in pewter—for covering houses, water pipes, &c.—with arsenic used in making shot—manufacture of patent shot—uses of litharge in glass-making, glazing pottery, and as a pigment—manufacture of patent yellow—use of minium as a pigment—of cerusse as the basis of white paint, and in plasters—of sugar of lead in dying, calico printing, adulterating wines, &c.—and in medicine.

IRON. Found native—oxydated—united with the carbonic, phosphoric, and sulphuric acids—mineralized by sulphur—colour bluish white—hard—elastic—ductile—tenacious—magnetic—gives fire with flint—very difficult of fusion—when first obtained from its ore, *Crude*, or *Cast*

Iron; by exposure to heat, and hammering or rolling, converted into *Bar*, or *Malleable Iron*; this, by cementation, converted into *Steel*—welding—Iron easily rusts on exposure to air and moisture—burns in oxygen gas—decomposes water—unites with all the acids—with the sulphuric forms *Green Vitriol*—manufacture of green vitriol from iron pyrites—with vegetable astringents forms a black precipitate, the basis of ink and all black dyes—with Prussic acid forms Prussian blue—method of preparing it—properties of Prussic acid—has the strongest attraction for sulphur of any metallic body, hence used in decomposing metallic sulphures—gives their colour to almost all earthy mixtures—mixed with carbon forms *Carburet of Iron*, *Plumbago*, or *Black Lead*—unites with melted tin—manufacture of tinned plates.

The uses of iron very numerous, the following are some of the principal :

The Loadstone—in making magnets.

Hematite, *Emery*, and *Colcothar*—in polishing glass, &c.

Boles, *Ochres*, *Umber*, &c.—as the basis of pigments, and in colouring pottery and enamels.

Plumbago—for pencils, protecting iron from rust, lubricating machinery, crucibles, and furnaces.

Cast Iron—for cannon and cannon-balls, bridges, gates, and railings; furniture, utensils and vessels

fels of various kinds, as grates, boilers, window-frames, &c.

Bar Iron—for wire, horse shoes, nails, bars, and fastenings of all kinds; ploughshares, fire-arms, &c. and with tin, tinned ware.

Steel—for cutting and pointed instruments in general, springs, tools and utensils, &c.

Salts of Iron—in dying black, brown, &c.—and making ink.

Prussian Blue—in dying, and as a pigment.

The Rust and Salts of Iron—used in medicine.

COPPER. Found native—in the state of oxyd—with the carbonic, arsenic, sulphuric, and muriatic acids—vitriol springs—mineralized by sulphur and arsenic—in combination with iron and lead—colour of a brilliant red—taste and smell disagreeable—sonorous—one of the most ductile and malleable of metals—slightly oxydates on exposure to air—melts in a white heat, and burns with a greenish flame—soluble in all acids and most other liquid menstrea—with the sulphuric acid forms *Blue Vitriol*—with the acetous acid forms *verdigris*—manufacture of verdigris at Montpellier—Nitrate of copper decomposed by lime forms *verditer*—mode of preparing it—dissolved in ammonia gives a beautiful blue purple—unites with most metals—with
zinc

zinc forms brass—manufacture of brass—is an essential component part of bronze, bell-metal, speculum metal, pinchbeck, &c.

Uses—Lapis lazuli in the preparation of ultramarine—verditer and verdigris in painting—blue vitriol in dying—copper in sheathing ships, bolts, plates, boilers, coins, &c.—Brass, and the other alloys in cannon, bells, statuary, utensils of various kinds, wire, &c.

All the salts of copper are poisonous.

SILVER. Found native—combined with the muriatic and sulphuric acids—mineralized by sulphur and arsenic, and united with antimony, iron, and lead—is of a splendid white colour, very malleable and ductile, without smell or taste—method of working silver ores, and refining by cupellation—melts in a full red heat, and does not oxydate on exposure to air—soluble with ease in the nitric acid, forming a salt intensely bitter and corrosive, staining animal matter black, and which, when fused, forms *Lunar Caustic*—precipitated from its solution by the muriatic acid, forming *Luna Cornea*; and, in the metalline state, by quicksilver, forming the *Arbor Dianæ*—liable to be tarnished by sulphureous vapours.

Alloyed with copper, used in coinage and plate.

GOLD.

GOLD. Found native—alloyed with silver, copper, or iron, and mineralized by sulphur and arsenic—of a bright yellow colour—the most ductile and malleable of all metals—gold leaf transparent—very soft—without smell or taste—mode of obtaining it from its ores, and separating it from silver—melts in a full white heat—not altered by exposure to air—soluble only in the nitro-muriatic and oxy-muriatic acids—the solution stains animal substances purple—precipitable from its solution by a solution of tin, in the form of a purple powder, called *Purple Powder of Cassius*—also precipitated by æther and volatile oils in a metallic form—precipitated by ammonia, and dried explodes with a moderate heat—*Aurum Fulminans*—soluble in the alkaline sulphures—unites with all metals—rendered very pale and brittle by arsenic—with copper becomes more fusible, of a deeper colour, harder, and more elastic—with silver forms the green gold of the jewellers.

Used for coin, ornaments, in gilding—different modes of gilding—gold lace.

PLATINA. Found only native in small grains of a dull silver colour—malleable and ductile—the heaviest of all bodies—the most difficult of fusion of all metals—at a full white heat capable of being welded—unalterable by exposure to air—soluble like gold in the oxy-muriatic and
nitro-

nitro-muriatic acids—more fusible when alloyed with arsenic—capable of a high polish.

Used for reflectors of telescopes and assay crucibles.

XII. GENERAL OUTLINE OF MINERALOGY.

Classification of earths and stone—external characters and method of analysis—geological observations—fusibility of different earthy mixtures and metallic oxyds—manufacture of enamel and artificial gems—analysis of mineral waters.

XIII. MINERAL INFLAMMABLES.

NAPHTHA, PETROLEUM, or MINERAL TAR. In its purest state liquid, colourless, highly inflammable, the lightest of all fluids—but generally found coloured, cohesive, solid—anciently used instead of mortar—used in Persia for lamps.

COAL. Found in strata at different depths—method of working coal-pits—theories of the origin of coal—different species—*Cannel, Newcastle, Scotch, &c.*

Used as fuel—cannel coal in ornamental works.

JET. Colour pure black—capable of a fine polish—electric—burns in a strong heat with a fetid odour—affords an oil and acid liquor on distillation.

Used for ornaments, toys, &c.

AMBER.

AMBER. Found on the sea shore in various places, chiefly in the Baltic—colour varies from pale straw to dark brownish red—moderately hard, brittle—takes a high polish—is electric when rubbed—inflames readily, and gives out a peculiar odour—on distillation gives an acid crystallizable salt, called *Acid of Amber*, and an oil of a pungent smell, *Oil of Amber*—which, with pure ammonia, forms *Eau de Luce*.

Used for ornaments—in varnishes—*Eau de Luce* in medicine.

THE VEGETABLE KINGDOM.

XIV. STRUCTURE OF VEGETABLES.

Their nutrition and growth—influence of light—vegetable transpiration—common juice or sap—formation of the vegetable principles.

XV.

GUM MUCILAGE. Brittle—dry—insipid—forms a viscid solution with water—insoluble in alcohol—*Cherry-tree Gum—Gum Arabic—Gum Senegal—Gum Tragacanth.*

Used in pigments—calico-printing — glazing ribbands, &c.

FÆCULA. Pulverulent—dry—white—insipid — soluble in warm water—coagulates in boiling—insoluble in alcohol—found chiefly in seeds and bulbous roots—*Cassava—Sago—Starch—Salep.*

Used principally as food and hair powder.

SACCHA-

SACCHARINE MUCILAGE. A sweet viscid juice—soluble in water—separable by alcohol into sugar and mucilage—dries with difficulty, and attracts moisture from the air—the only substance capable of the vinous fermentation—forms the principal part of the *Sap*—found abundantly in most ripe fruits, such as *Figs*, *Raisins*, &c.—procured from the *Manna Ash-tree*, the *Sugar Maple*, the *Birch*, the *Palm*, the *Sugar Cane*—from *Liquorice* and other roots—from the nectaries of all plants forming *Honey*, and in the process of *Malting*—method of preparing sugar—and malting.

VINOUS FERMENTATION. Peculiar to Saccharine mucilage—circumstances necessary for its production—process, and its products—use of ferments—*Wine*, *Malt Liquors*, *Cyder*, *Perry*, *Mead*, *Made Wines*, &c.—distillation of spirits from fermented liquors—*Brandy*, *Rum*, &c.—*Spirit of Wine*—*Alcohol*—its properties—used as a menstruum of resins and essential oils, for preserving animal substances, &c.—*Ether*—how prepared—its properties—*Sulphuric and Nitric Ether*—*Tartar*.

ACETOUS FERMENTATION. Takes place in mucilage—production of vinegar—*Distilled Vinegar*, *Acetate of Copper*, and *Radical Vinegar*, or *Acetic Acid*.

Used

Used in food, pickling, preparation of white lead, sugar of lead, verdigris, &c.

XVI. VEGETABLE ACIDS, NATIVE VEGETABLE ACIDS, AND ACIDULA.

CITRIC ACID. Obtained from lemon juice—crystallizable—of a very strong acid taste—lemon juice, how preserved and concentrated—lemonade.

GALLIC ACID. Procured from all vegetable astringents—mode of obtaining it from galls—crystallizes—produces a black precipitate with all salts of Iron.

Use of galls and vegetable astringents.

MALIC ACID. Procured from unripe apples—not crystallizable.

Not applied to any use.

BENZOIC ACID. Obtained from benzoin, balsam of Peru, &c.—of an acrid taste—fragrant, crystallized—called *Flowers of Benzoin*.

TARTAREOUS ACID AND ACIDULUM. Found deposited in the inside of wine casks—purified from crude tartar—*Cream of Tartar*—of difficult solution in water—mode of procuring the
Tartareous

Tartareous Acid, Tartrite of Potash, or Soluble Tartar, Tartrite of Soda, or Rochelle Salt.

Tartar used principally in dying, in metallurgy, &c.

OXALIC ACID AND ACIDULUM. Found native in the juice of the sorrel, called *Salt of Sorrel*—*Oxalic Acid* procured artificially from sugar, &c.

ACIDS FORMED BY THE ACTION OF FIRE.

PYRO-TARTAREOUS. Procured from the distillation of tartar.

PYRO-MUCOUS. Obtained from the distillation of gummy, saccharine, and farinaceous mucilage, &c.

PYRO-LIGNEOUS. Produced from the distillation of wood.

These three acids are distinguished by their empyreumatic taste, and are not applied to any use.

ACIDS FORMED BY THE NITRIC ACID.

OXALIC ACID. Prepared from sugar, wool, hair, silk, &c.—crystallizes—precipitates lime from all its solutions.

Used as a chemical test.

CAMPHORIC ACID. Procured from camphor—crystallizes—of a bitter taste.

SUBERIC

SUBERIC ACID. Prepared from Cork—concrete—
not crystallizable.

General observations on the mutual conversion of the vegetable acids.

XVII. FIXED VEGETABLE OILS.

Procured mostly by expression—of an unctuous feel, and generally insipid—inflammable—insoluble in water and alcohol—with alkalies forming soaps—procured chiefly from kernels and seeds.

OLIVE OIL. Obtained by expressing the fruit of the olive tree—method of preparing it, and purifying—cause of rancidity.

OIL OF ALMONDS. Procured from sweet and bitter almonds—insipid

OIL OF RAPE OR COLE-SEED.

OIL OF BEN. Procured from the Ben Nut in Egypt and Arabia—acid.

Used as the basis of perfumes.

CASTOR OIL. Obtained from the *Ricinus Palma-Christi*.—Used in medicine.

The above oils are easily fixed by cold—not easily thickened by exposure to air—form soaps with the mineral acids.

LINSEED OIL. Prepared by roasting the seeds of flax, and pressure—rendered drying by boiling with litharge.

NUT OIL. Always fluid in our climates.

POPPY-SEED OIL.

HEMP-SEED OIL.

The above are easily rendered drying by metallic oxyds, and thickened by exposure to air—freeze with great difficulty.

BUTTER OF CACAO, or PALM OIL. Procured from the Cacao nut—yellow, concrete—of a strong fragrant smell.

Used as food, and in soap-making.

BUTTER OF COCO. Procured from the chocolate nut—concrete.

Used in the preparation of chocolate.

VEGETABLE WAX. Imported from China.—prepared from the catkins of the candleberry myrtle (*Myrica Cerifera*); of the gale (*Myrica Gale*); or of the birch tree—concrete and fragrant.

Used for making candles.

General uses of vegetable oils—as food—for giving light—for dressing wool, &c.—for various
nishes

nishes and mixing colours—in the finer kinds of soap—manufacture of soap—construction of lamps, &c.

XVIII. VOLATILE, OR ESSENTIAL OILS.

Highly odorous — of an acrid taste — volatilized with a gentle heat — soluble in alcohol — contained in glands distributed sometimes over the whole plant, but generally confined to the flower and fruit — Extracted either by expression or distillation — contain the aroma or odorant principle of vegetables — all inflamed by the nitric acid.

OIL OF TURPENTINE. Procured by the distillation of turpentine — is a solvent for resins.

Used largely in varnishing and mixing painters colours.

The other essential oils are used principally as perfumes, cordials, and medicines — of these the chief are, *Oil of Lavender, Cinnamon, Cloves, Pepper, Nutmegs, Wormwood, Juniper-berries, Peppermint, Roses, &c. &c.* — Process for making *Attar of Roses*.

CAMPHOR. Resembles the essential oils, but concrete, and not inflammable by the nitric acid.

Used in medicine.

RESINS. Dry—inflammable—soluble in alcohol and oils—insoluble in water—Of these the principal are, *Balm of Mecca*—*Tacamahacca*—*Guaia-cum*—*Dragon's Blood*—*Sandarach*—*Labdanum*—*Turpentine* in general.

Used in cements, varnishing, and various arts—also in medicine—preparation of pitch, rosin, tar, and oil of turpentine and lamp-black.

GUM RESINS. Are resins mixed with an extractive matter—soluble partly in water and partly in alcohol—of these the principal are, *Olibanum*—*Galbanum*—*Scammony*—*Aloes*—*Asafætida*—*Gamboge*—*Myrrh*—*Opium*, &c.

Used almost solely in medicine.

BALSAMS. Are resins mixed with a fragrant concrete acid salt—soluble in alcohol—the salt extracted by boiling water or by sublimation—*Benzoin*—*Balsam of Tolu*—*Storax*.

VARNISHES. Different kinds—oil, spirit, and turpentine varnishes—mode of preparing—*Copal Varnish*.

ELASTIC GUM, or CAOUTCHOUC. How procured—elastic—inflammable—soluble in ether, sparingly in oil of turpentine.

Used for effacing pencil marks, varnishing balloons, &c.

XIX. VEGETABLE EXTRACT.

Procured chiefly from the wood, bark, and roots of plants—dry—not inflammable—bitter—of a brown red colour—soluble in water—absorbs water from the air—decomposed by acids and metallic salts—*Extract of Peruvian Bark—Chamomile—Gentian, &c.*

Used solely in medicine.

XX. GLUTEN.

Found chiefly in wheat flour—ductile—tenacious—elastic—when hardened is semitransparent and brittle—insoluble in water—burns with a fetid smell like horn—very similar to animal matter.

Manufacture of bread.

XXI. WOOD AND VEGETABLE FIBRE.

The most indestructible part of vegetables—insipid—insoluble—combustible—yields the pyro-ligneous acid by distillation—composes the principal

part of the bark and wood—*Flax, Hemp, Matting, Cotton, &c.*—Growth of timber—different kinds of wood, and their uses.

CHARCOAL. How prepared—black, light, insipid—inalterable in close fire—heated, with access of air, it burns with intense heat, and is converted into carbonic acid—strongly attracts vegetable and animal mucilage.

Used as fuel—in gunpowder—for clarifying mucilaginous liquors, &c.

ANALYSIS OF VEGETABLES BY FIRE. Volatile products—chiefly water and carbonic acid—residuum, alkaline, and neutral salts, metallic oxyds, &c.

XXII. SUBSTANCES USED IN MEDICINE, OR MATERIA MEDICA.

Procured chiefly from the vegetable kingdom—arranged according to their sensible qualities, chemical properties, or medicinal effects.

THE ANIMAL KINGDOM.

XXIII. GLUTEN, OR ANIMAL FIBRE.

Of a fibrous texture—insoluble in water—soluble in some acids—contains much azot—constitutes the principal part of animal flesh—found abundantly in the blood—analysis of *Blood*.

ALBUMEN. Insoluble in water—soluble in alkalies—coagulates by heat, acids, oxyds, &c.—found in the serum of blood, in milk, eggs, and all the white parts of animals—analysis of *Milk, Butter, Cheese, Whey, Sugar of Milk, Lactic, and Saccholactic Acids*.

ANIMAL GELLY. Soluble in water—congeals when cold into a gelatinous substance—resoluble in water—found in the serum of blood, in the skin, tendons, cartilage, bones, and all the white parts of animals.

Used for food and in the arts—preparation of *Glue, Size, Isinglass, &c.*

SACCHARINE MUCILAGE. Found chiefly in whey—resembles vegetable saccharine mucilage—fermentable—Preparation of *Koumifs*.

XXIV. ANIMAL OIL.

Inflammable—insoluble in water—forms soaps with alkalies—very similar to vegetable oils, but differs from them in containing the *Sebacic Acid*—found fluid in fishes—more solid in birds, and especially in graminivorous quadrupeds—*Train Oil, Fish Oil, Grease, Fat, Tallow, Lard, Suet, Butter, &c.*

Purification of oils.

Spermaceti—How prepared—*Brains—Wax.*

Used for food—lamps and candles—soap-making—leather-dressing—in medicine, &c.—Conversion of flesh into a substance resembling *spermaceti*.

XXV. ANIMAL ACIDS.

Lactic, Saccholactic, Sebacic, Prussic—already mentioned.

Phosphoric Acid. See *Phosphorus.*

Formic Acid—procured from ants by distillation—very pungent—not crystallizable.

XXVI. EXTRACTIVE MATTER.

Of a brown colour—soluble in water—sapid—found mostly in old animals—obtained from the flesh by decoction—preparation of soups.

RESINOUS EXTRACT—dry, inflammable, soluble in alcohol—strongly odorous—*Castor, Musk, Ambergris, Civet.*

Also found in *Bile*—analysis of bile.

XXVII. CALCAREOUS SALTS.

CARBONATE OF LIME. Composes the exterior covering of eggs, and of all shell-fish—*Pearl, Mother of Pearl, or Nacre, Coral, Oyster-shell, Cuttle-Fish bone, &c.*

Phosphate of Lime—forms the earthy part of bones, hoofs, horns, teeth, &c.—*Bones, Ivory, Horn, Tortoise-shell, &c.*—Manufacture of hartshorn, bone-ash, lamp-black, &c.

XXVIII. ANIMAL NUTRITION.

General account of vegetable and animal substances used as aliment.—Preparation of food.—Art of cookery.—Nutrition, how performed in man, carnivorous and graminivorous quadrupeds, birds fishes, serpents, &c.—Comparison between alimentary matter and animal principles.—Ultimate analysis of animal and vegetable matter.

XXIX.

XXIX. PHOSPHORUS.

Semi-transparent—of a consistence like wax—easily liquefies—luminous at the common temperature of the atmosphere exhaling dense fumes of the smell of garlic—with a gentle heat takes fire and burns with a bright white flame—soluble in oils rendering them luminous—combines with the alkalies and lime decomposing water and giving out *phosphorated hydrogenous gas*—with oxygen forms phosphoric acid.

Phosphoric Acid—concrete—white—deliquescent—of a strong acid taste—when heated strongly melts into a glass at first opaque, afterwards transparent—found united with soda and ammoniac in urine forming a triple salt called *Microcosmic Salt*, united with lime constitutes the earth of bones or *Calcined Hartshorn*—found in most animal matters, some vegetables, and as a mineral—phosphate of lead and iron also found native.

Phosphate of Lime.—Used in making cupels and crucibles, and in some enamels.

Phosphate of Soda.—Used in medicine—microcosmic salt used as a flux in assaying—preparation of phosphorus from phosphate of lime.

XXX. ANIMAL TEGUMENTS.

WOOL, HAIR, SILK and FEATHERS. — Have great resemblance to each other in chemical properties—soluble in alkalies, forming a kind of soap—treated with nitric acid yields the oxalic acid—scouring and preparing wool and silk for manufacture.

SKIN—Consists of condensed cellular substance mixed with animal oil, &c.—process of *Leather Dressing*, making *Parchment* and *Vellum*, *Shagreen*, *Fish Skin*—is rendered harder and more unalterable by vegetable astringents—process of tanning.

SPONTANEOUS DECOMPOSITION OF ANIMAL AND VEGETABLE MATTER.—Putrefaction—vegetable mold—theory and use of manures.

SUBSTANCES USED IN DYING.—History of the art of dying—particular account of the animal, vegetable, and mineral colouring matter—preparation of dying drugs—affinity of wool, cotton, silk, linen, &c. for different colours—use of mordants—process of dying and calico printing.

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